STAT

12 October 1970

Ref: W. O. 6847

STAT From: [redacted]

Mailing Address:

STAT [redacted]

To. U. S. Government

Subject: [redacted] STAT

Dear George:

Enclosed are four (4) copies of the Final Technical Report on the subject contract. One copy has been forwarded directly to the Contracting Officer.

Very truly yours,

[redacted] STAT

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October 8, 1970

Reference: 6847

FINAL TECHNICAL REPORT

[redacted]

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"Experimental Work for
Improvement of Lamp
Performance for High
Intensity Light Tables"

# FINAL TECHNICAL REPORT

## Improved Lamp Performance

## Ref. 6847

CONTENTS



Approved For Release 2005/02/17 : CIA-RDP78B04770A001100080009-4

# FINAL TECHNICAL REPORT

## Improved Lamp Performance

## Ref. 6847

### 1. Program

A set of specific experiments were conducted to determine whether improvement could be obtained in lamp performance by introduction of certain concepts. A lamp consists of:

(a) Luminous Grid

(b) Lamp Box

(c) Diffuser

(d) Dimmer

(e) Transformer

Each of the above items was a candidate for improvement. The experimental program and work statement was delineated in detail in [redacted] Proposal P-141 and activity and results were reported in detail in the Monthly Technical Reports. This report contains a summary of the findings.

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2. Goals

(a) Obtain a uniform 3000 foot lamberts or more brightness without the use of blowers, coolant or other active means to maintain a cool viewing surface.

(b) Obtain uniform dimming down to 100 foot lamberts or less without discernable flicker.

(c) Limit temperature rise of viewing surface to $35^{o}F$ or less at maximum intensity by heat sinks or convection.

(d) Reduce size and weight of the transformer required.

(e) Most importantly, keep the manufacturing cost at a competitive level.

## 3. Summary of Results

### 3.1 Maximum Intensity

An increase in maximum intensity was obtained by:

(a) Utilizing the 2067 formulation of milk white plexiglass, 1/8 inch thick, for the diffuser.

(b) A modified Sylvania sign white 5500 phosphor blended with red phosphor additives (comparative tests were made on single tubes, not grids).

(c) Limiting the grid temperature to 140°F maximum by whisper fan convection currents.

(d) Placing the diffuser approximately 1/2 inch above the grid.

(e) Overvolting the grid with a step up transformer.

A maximum intensity of approximately 3200 foot lamberts was obtained. To maintain the intensity it was necessary to use a whisper fan to gently stir convection air currents below the lamp box. We exceeded our original goal by a small amount.

No increase in maximum intensity was obtained by:

(a) High efficiency reflecting paint.

(b) Diffusers of higher transmission than the 2067

formulation recommended above. In addition, grid lines could be seen through the diffuser.

(c) Varying the partial pressure and additive gases in the grid. Apparently the commercial product is pretty well optimized in this respect for best lamp performance.

3.2 Minimum Intensity

An improvement in low intensity was obtained by heating the lamp box with resistors to maintain the grid temperature at 140°F.

No improvement in low intensity was obtained by using a half wave rectifier in the dimmer. Dimming down to 20 foot lamberts was obtained with no discernable flicker. The key to flicker free dimming is control of the temperature of the grid. If the grid is allowed to cool it flickers. Auxiliary resistors as heaters are needed since power dissipation of the grid at these low intensity levels will not maintain adequate grid temperature. We did better than our original goal by a considerable amount.

3.3 Uniformity

Good uniformity was obtained by raising the outer strands of the luminous grid by one diameter and by using a slightly smaller diameter tubing for the outer strands. A major element in uniformity of illumination is the uniformity of the temperature of the grid.

General uniformity over the grid face and edges of about ± 3% was obtained with the extreme corners dropping off to -6%. One edge, which was cooler than the other parts of the grid was about -10% and one cool corner was about -13%.

Although no specific goal for uniformity was established, results were considerably better than we expected.

3.4 Viewing Surface Temperature

Since it was necessary to use a whisper fan to maintain intensities and uniformities, the temperature measurements were made under the same conditions.

Temperature rise of the viewing surface did not exceed 22°F (97°F at an ambient of 75°F) under the most extreme conditions. This was considerably better than the original goal of 35°F maximum temperature rise.

3.5 Transformer

It was proposed to reduce transformer size and weight by increasing the excitation frequency. However, no technical approach was found which would pass the test of maintaining manufacturing cost at a competitive level. It was necessary to:

(a) Rectify the 60 cycle line power

(b) Generate the desired frequency at adequate power levels

(c) Fabricate special transformers.

The components for the most promising approach were found to be 5 to 6 times as costly as those for 60 cycle line power.

No experimental work was done on this item.

We were disappointed in the results of this effort and the original goal was not achieved.

### 3.6 Lamp Life

Lamp life was not one of the parameters investigated in this program. In technical discussion however, it became apparent that a reasonable lamp life of these experimental grids was an important question. To obtain data on lamp life, it was proposed that an experimental grid be operated for an extended period and intensity be measured from time to time. On a statistical basis, a lamp life of 2000 to 4000 hours or more should be obtained.

4. Recommended Configuration

- 6500 Snow White or 5500 Sign White grid phosphor. 10 mm diameter grid tubing spaced about 3/4 inch center to center with outer strands raised on diameter.
- For best uniformity, outer raised strands should be 8 mm diameter tubing.
- Base plate of lamp box should be aluminum, 1/8 inch to 1/4 inch thick.
- Paint lamp box interior with a common flat white paint for best reflectivity.
- Use a whisper fan below the lamp box base plate to stir up gentle convection currents to obtain maximum lamp intensity and uniform heat distribution.
- Attach five resistors, 10 watt, 50 ohm, to base plate at low lamp intensities to obtain good flicker free operation.
- Control both the fan and the resistors with a thermocouple on the grid to maintain optimum grid temperature (in this case 140$^{o}$F).
- Diffuser should be formulation 2067 milk white plexiglas, 1/8 inch thick spaced 1/2 inch or more above the lamp grid.

## 5. Conclusions and Recommendations

The goals of the experimental work were met and exceeded in all cases except reduction of transformer size.

The lamp configuration recommended above will provide maximum intensity over 3000 foot lamberts, minimum intensity down to 20 foot lamberts, uniformity of ±10% or perhaps better and a viewing surface temperature rise of less than 25°F.

It is recommended that data be obtained on lamp grid life by making intensity measurements over an extended period of time.

Reports 52148



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September 30, 1970

Ref: W. O. 6847

MONTHLY TECHNICAL REPORT #4

STAT Contract No. [redacted]
Improved Lamp Performance

1. Activity

Work on this contract is now complete and a final report is in preparation. It will present a summary of our findings and recommendations for a best lamp configuration.

Work on the high frequency excitation was disappointing. It was found that none of the solutions considered were cost competitive to the standard 60 cycle power line frequency components. Production cost of the high frequency components were 4 to 5 times the cost of the standard 60 cycle components.

2. Planned Activity

A final report will be completed and submitted. A demonstration for a technical representative of the Contracting Officer is planned next week. This will complete work on this contract.

3. Other Comments

STAT A meeting with the Technical Representative of the Contracting Officer was held at [redacted] on September 24, 1970. Results were discussed and tests in progress were observed. The tests were concerned with brightness obtained at optimum grid temperature.

Lamp grid life expectancy was discussed. It would be a simple matter to make extended operating time tests to measure grid life. This will be discussed further in the final report.

September 30, 1970

Ref: W. O. 6847

To: U. S Government

From: [redacted]

Mailing Address

[redacted]

Subject: [redacted]

Dear George:

Enclosed are four copies of the Monthly Technical Report No. 4 on the subject contract. One copy has been forward directly to the Contracting Officer.

Very truly yours,

[redacted]

WAS/ls

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